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IS 9809 (1981): Test chart for crankshaft grinding machines
[PGD 3: Machine Tools]

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Indian Standard (Reaffirmed 2003)

TEST CHART FOR CRANKSHAFT GRINDING MACHINES

1. Scope — Describes both geometrical and practical tests on crankshaft grinding machines and the corresponding permissible deviations with reference to IS : 2063-1962 'Code for testing machine tools'.

1.1 It deals only with the verification of accuracy and applies neither to the testing of the running of the machine (vibrations, abnormal noises, stick-slip motion of components, etc) nor to the machine characteristics (speeds, feeds, etc) which shall generally be checked before testing the accuracy.

2. Preliminary Remarks

2.1 To apply these tests, reference shall be made to IS : 2063-1962 especially for installation of the machine before testing, warming up of spindles and other moving parts, description of measuring methods and recommended accuracy of testing equipment.

2.2 The sequence in which the geometrical tests are given is related to the sub-assemblies of the machine and does not define the practical order of testing. In order to make checking or mounting of instruments easier, tests may be carried out in any convenient sequence.

2.3 When inspecting a machine, it is necessary to carry out all the tests described in this standard, excepting those tests which may be omitted in mutual agreement between the buyer and the manufacturer.

2.4 Practical tests shall be made only with finishing cuts.

2.5 When establishing the tolerance for a measuring range different from that indicated in this standard (*see* **2.3.1.1** of IS : 2063-1962), *it shall be taken into consideration that the minimum* tolerance is 0·002 mm. For any proportional value, the calculated value shall be rounded off to the nearest 0·001 mm. However, the least count of all measuring instruments need not be finer than 0·001 mm.

2.6 Whenever alternate methods of testing are suggested, the choice of actual method of testing is left to the manufacturer.

2.7 For the purpose of this standard, various methods of expressing permissible deviation are employed, each having a particular type of application. The methods employed are as follows:

000/000 for deviations of perpendicularity which are ratios.

000 for any length of 000 for deviations of straightness and parallelism; this expression is used in fact for local permissible deviations, the measuring length being obligatory.

000 for 000 for deviations of straightness and parallelism; this expression is used to recommend a measuring length but in this case the proportionality rule comes into operation if the measuring length differs from those indicated.

3. Testing Instruments — The testing instruments shall be of the approved type and shall be calibrated at a recognized temperature conforming to the relevant published Indian Standards.

4. Accuracy Requirements — The tests to be carried out, the instruments required, the maximum permissible deviations and the manner of carrying out the tests shall be as detailed in the test chart.

Adopted 23 March 1981

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P[redacted] Gr 6

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Machine Tools, Machine Tool Elements and Wood-Working Machines Sectional Committee, EDC 11; Panel for Grinding Machines, EDC 11/P-18 [Ref : Doc : EDC 11(2878)]

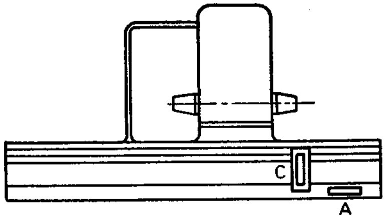
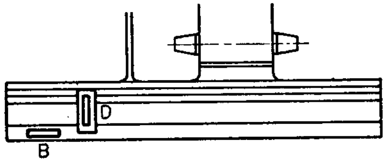
TEST CHART FOR CRANKSHAFT GRINDING MACHINES

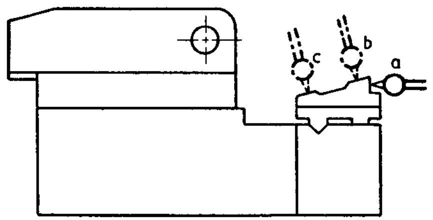
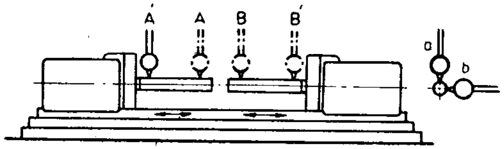
TYPE .... CUSTOMER..........................

MACHINE NO. .... ORDER NO. .... DATE.................... INSPECTOR..........................

I GEOMETRICAL TESTS

All dimensions in millimetres.

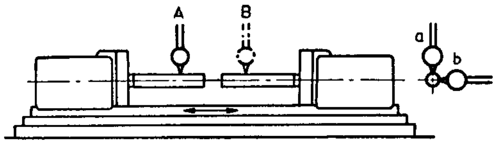
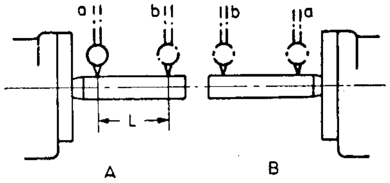
Sl No.	Figure	Object	Measuring Instruments	Reference to Cl No. of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	 	Straightness of the slideways in vertical plane: a) Longitudinal direction b) Transverse direction	Precision level or any other optical or other instruments Precision level, straight edge measuring bridge	**3.3.1** and **5.1.1.2** Readings shall be taken at regular intervals throughout the length of the bed on slideways Readings taken with table removed. Measuring length 500 mm a) Precision level placed longitudinally to bed on guideways A & B b) Precision level on measuring bridge (straight edge or similar) transversally to bed on position C & D. Transverse work table for measuring A & C, completely to left, for measuring B & D completely to right On machines having more than 1 000 mm grinding length, remove work table, then apply precision level at intervals of 500 mm longitudinally along the table guides and transversally by measuring bridge (straight edge or similar) and take readings in this manner	a) 0·02/1 000 for machines up to 3 000 mm grinding length Over full length 0·03 *Max* For machines over 3 000 mm grinding length Over full length 0·04 *Max* b) 0·02/1 000	

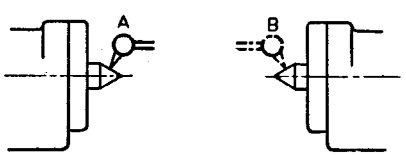
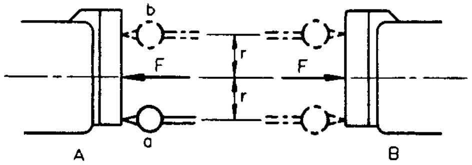
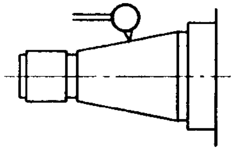
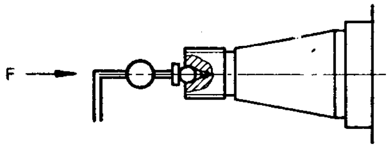
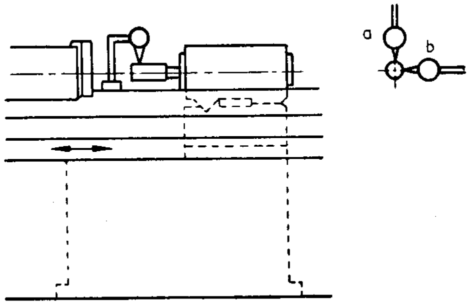
2		Parallelism of butting surface & clamping surface of table with table motion	Dial gauge	**5.3.2.2** (a) Dial gauge placed on a fixed part of the machine and the readings taken on the butting surfaces at position '*a*', '*b*' and '*c*' by traversing the table longitudinally	For machines with table length up to 1 000 mm 0·01 above 1 000 mm and up to 3 000 mm 0·02 over 3 000 mm 0·03	
3		Parallelism of the axis of the work head spindle to the table traverse: a) Vertically b) Horizontally	Dial gauge and test mandrel of 300 mm length	**5.3.1.2(a)** and **5.3.2.2(b)** The table setting should be the same as that for test at Sl No. 2 above	a) For machines with swing dia $\leqslant 500$ — 0·02 for 300 > 500 $\leqslant 1\,000$ — Not less than 0·01 and not more than 0·03 for 300 $> 1\,000$ — Not less than 0·03 and not more than 0·05 for 300. Free end of the mandrel inclined upwards only b) 0·02 for 300 Free end of the mandrel inclined towards the wheel head only	

(*Continued*)

I GEOMETRICAL TESTS — *Contd*

All dimensions in millimetres.

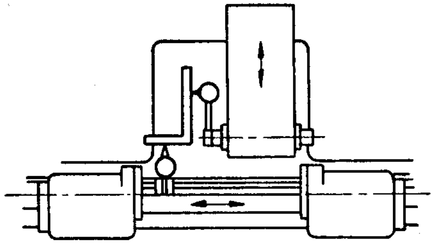
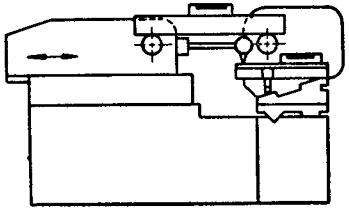
Sl No.	Figure	Object	Measuring Instruments	Reference to Cl No. of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
4		Equality of the height and sidewise position of the axes of the work head spindles: a) Vertically b) Horizontally	Dial gauge and two identical test mandrels	Set table in null position. Mount test mandrel on the work spindle and bring it to the mean position of concentricity error. Apply dial gauge, first (a) vertically & then (b) horizontally on the test mandrel. Table shifted from *A* to *B* and indicated difference in respective position of the mandrel is read off	a) 0·02 Right hand work spindle head to be higher only b) 0·02 Right hand work spindle head to be nearer to the working side only **Note** — Measuring length about 2/3rd of the grinding length	
5		True running of taper bore of spindle: a) Near to the spindle nose b) At a distance *L*, where $L = 300$	Dial gauge and test mandrel	**5.5.2.1(b)**	a) 0·02 b) 0·04 for 300	

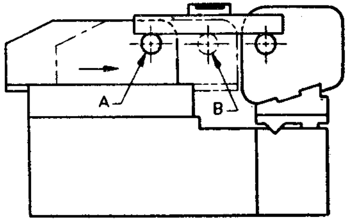
6		Runout of the work head spindle	Dial gauge	**5.5.1.2(a)** and **5.5.2.1(b)** Hold the dial gauge normal to the cone of the centre at '*A*'. Rotate the work spindle and reading noted. Test to be repeated for '*B*'.	0·02	
7		Axial slip and runout of the flange of the work head spindle	Dial gauge	**5.5.2.1(b)**, **5 5.2.2(a)** and **5.5.3.2** **Note** — *F* is the constant axial force on the spindle to eliminate axial bearing end play. If this is required, then its value to be specified by the manufacturer.	0·01/100 measuring radius *r* *Max* 0·04	
8		True running of taper of grinding spindle	Dial gauge	**5.5.1.2(a)** Apply dial gauge to the periphery of taper (vertically to the taper shroud) Rotate grinding spindle and read off deflection of dial gauge	0·005	
9		Axial slip of the grinding spindle	Dial gauge	**5.5.2.1(b)** **Note** — *F* is the constant axial force on the spindle to eliminate axial bearing end play. If this is required, then its value to be specified by the manufacturer.	i) 0·01 for non-plunged type ii) 0·005 for full form plunged type	
10		Parallelism of the grinding spindle axis to the table movement: a) In horizontal plane b) In vertical plane	Dial gauge and test mandrel	**5.3.1.2(a)** and **5.3.2.2(b)**	a) 0·01 for 100 Free end of the mandrel inclined towards table only b) 0·01 for 100 Free end of the mandrel inclined upwards only	

(*Continued*)

I GEOMETRICAL TESTS — *Contd*

All dimensions in millimetres.

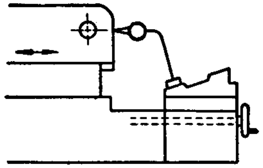
Sl No.	Figure	Object	Measuring Instruments	Reference to Cl No. of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
11		Squareness of the movement of the grinding spindle head to the longitudinal movement of the table	Dial gauge and square	**5.4.2.3** Grinding spindle head at the farthest position at back Square placed on table with one arm of the square adjusted parallel to the movement of the table. Dial gauge connected to the wheel slide touching the other arm of the square during the transverse movement	0·01/100 Over the total infeed *Max* 0·02	
12		Equality of height of grinding spindle and work head spindle axes	Precision level, test mandrel, dial gauge and adjustable measuring bridge	Adjustable measuring bridge placed on the table Mount the dial gauge on the grinding wheel spindle. Put the dial gauge pin on the measuring face of the measuring bridge. Measuring face set parallel to the guideways of the grinding spindle in the direction of travel through the movement of the grinding spindle on the guideways. Precision level is placed on the measuring face and reading taken Grinding spindle brought in the middle of the infeed Test mandrel mounted on the grinding spindle and work spindle and brought them to the mean position of the eccentricity error. Readings taken by placing the straight-edge with the precision level Measure the centre distance between the two mandrels and 'height difference' calculated as per Appendix A	0·20	

13		Height position of grinding wheel above the table at the limiting position of the wheel slide	Precision level, straight edge and test mandrel	Place the adjustable measuring bridge on the table Mounted dial gauge with stand on the grinding spindle. Put the dial gauge pin on the measuring face of the measuring bridge. Measuring face set parallel to the guideways of the grinding spindle in the direction of travel through the movement of the grinding spindle on the guideways. Reading taken by placing precision level on the measuring face Brought grinding spindle head at the rear most position '*A*' Mounted test mandrel on the grinding spindle and work spindle and bring them to the mean position of the eccentricity error. Placed straight edge with precision level and reading noted. Centre distance between two mandrels measured and height difference calculated as per Appendix A for this rear most position Bring grinding spindle head in the foremost position '*B*' and repeat the procedure as above and 'height difference' calculated as per Appendix A for foremost position Calculate the difference between the two values of 'height difference'	0·05 over total infeed	

(*Continued*)

I GEOMETRICAL TESTS — *Contd*

All dimensions in millimetres.

Sl No.	Figure	Object	Measuring Instruments	Reference to Cl No. of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)
14		Measurement of accuracy of repetition of finishing approach of the wheel positioning	Dial gauge	Six consecutive tests shall be carried out for the wheel positioning, the movement being obtained by a quick approach followed by a slow approach	0·002 5	

TEST CHART FOR CRANKSHAFT GRINDING MACHINES

TYPE.................................... CUSTOMER...........................

MACHINE NO. .... ORDER NO. .... DATE..................... INSPECTOR...........................

II PRACTICAL TESTS

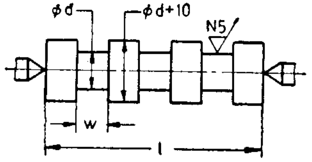
All dimensions in millimetres.

Sl No.	Figure	Nature of Test	Cutting Conditions	Checks to be Applied	Measuring Instruments	Reference to Cl No. of IS : 2063-1962 and/or Instructions for Testing	Permissible Deviations	Actual Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1		Working accuracy of machine while grinding a test piece (crankshaft)	As per manufacturers' recommendations **Note** — The manufacturer will recommend the type of grinding wheel and also its dimensions.	a) Circularity (roundness) b) Cylindricity	Dial gauge and V-block	**3.1, 3.2.2, 4.1** and **4.2** a) Test crankshaft set in Vee's Dial gauge stand with adjustable dial gauge set on middle of crankshaft seat at various position and maximum dial gauge movement observed b) Dial gauge on various positions	a) Machinings having a swing up to 500 0·005 Over 500 up to 1 000 0·01 Over 1 000 0·015 b) Up to seat width of 50 0·005 Over 50 up to 150 0.010 Over 150 0·015	

(*Continued*)

II PRACTICAL TESTS — *Contd*

All dimensions in millimetres.

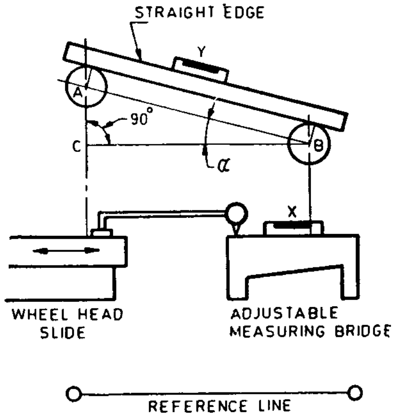
<table>
<tr><th>Sl No.</th><th>Figure</th><th>Nature of Test</th><th>Cutting Conditions</th><th>Checks to be Applied</th><th>Measuring Instruments</th><th>Reference to Cl No. of IS : 2063-1962 and/or Instructions for Testing</th><th>Permissible Deviations</th><th>Actual Error</th></tr>
<tr><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td><td>(5)</td><td>(6)</td><td>(7)</td><td>(8)</td><td>(9)</td></tr>
<tr><td>2</td><td>

<table>
<tr><th>Maximum Grinding Length of Machine</th><th>*l*</th><th>*d*</th></tr>
<tr><td>Up to 750</td><td>500</td><td>60</td></tr>
<tr><td>Over 750 up to 1 500</td><td>750</td><td>80</td></tr>
<tr><td>Over 1 500 up to 3 000</td><td>1 000</td><td>100</td></tr>
<tr><td>Over 3 000</td><td>1 500</td><td>120</td></tr>
</table></td><td>Working accuracy of the machine for test piece for grinding between centres (only for the machines for grinding the main bearing)
Note — Further measurements of work piece geometry to be decided.</td><td>Type and dimension of the grinding wheel, material of the test work piece, main bearing width '*W*' and number of spacing of main bearing within length '*l*' and grinding condition as per manufacturer's recommendation</td><td>a) Circularity (roundness)
b) Cylindricity</td><td>Dial gauge and V-block</td><td>**3.1**, **3.2.2**, **4.1** and **4.2**
a) Test crankshaft set in Vee's dial gauge stand with adjustable dial gauge set on middle of crankshaft seat at various positions and maximum reading noted
b) Dial gauge on various positions</td><td>a) Machines having swing up to 500 0·005
Over 500 up to 1 000 0·01
Over 1 000 0·015
b) Machines having work piece length up to 1 000 0·01
Over 1 000 0·02
Note — Surface to be convex only.</td><td></td></tr>
</table>

APPENDIX A

(*Geometrical Tests*, Sl No. 12 & 13)

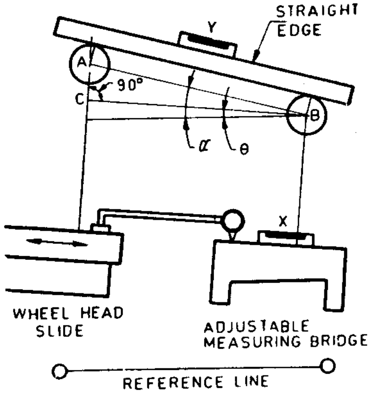
CALCULATIONS FOR MEASUREMENT OF HEIGHT DIFFERENCE



Condition 1

Formula

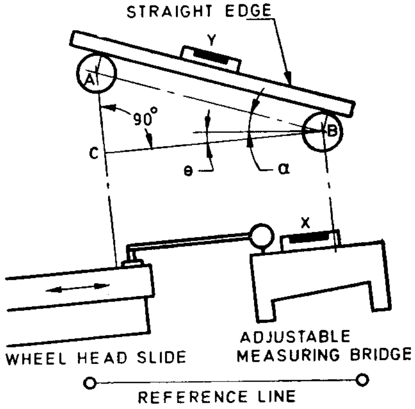
$AC = AB \times \text{Sin}\ \alpha$



Condition 2

Formula

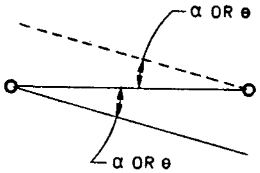
$AC = AB \times \text{Sin}\ (\alpha - \theta)$



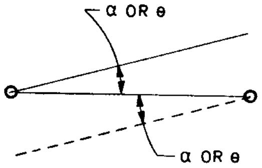
Condition 3

Formula

$AC = AB \times \text{Sin}\ (\alpha + \theta)$



ANGLE POSITION, POSITIVE



ANGLE POSITION, NEGATIVE

General

Formula

$AC = AB \times \text{Sin}\ (\alpha - \theta)$

A — Grinding spindle centre line/axis

B — Work head spindle centre line/axis

AC — Difference of height of centre line/axis of grinding spindle and work head spindle

θ — Angle measured by precision level '*x*' put on adjustable measuring bridge

α — Angle measured by precision level '*y*' put on straight edge

Notes — Use angles α and θ with proper signs as indicated above.

In an illustration position '*A*' is shown above position '*B*', but reverse can be the case.

By using above formula if value of '*AC*' comes to be.

Positive then position '*A*' is above position '*B*'.

Negative then position '*A*' is below position '*B*'.

EXPLANATORY NOTE

In preparing this standard, assistance has been derived from ISO 2433-1973 (E) 'Test condition for external cylindrical grinding machines with a movable table — Testing of accuracy'.

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